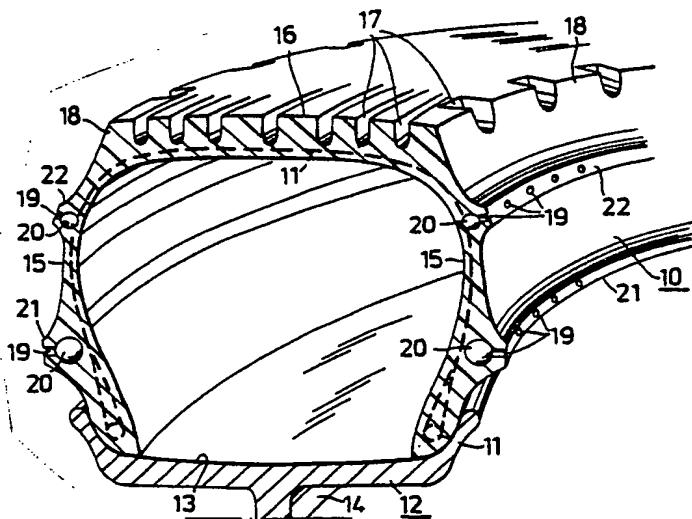




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(54) Title: A METHOD FOR BALANCING THE TYRES OF AUTOMOTIVE VEHICLES; A BALANCED VEHICLE TYRE; AND A VEHICLE TYRE TO BE BALANCED



## (57) Abstract

For the purpose of balancing a vehicle tyre (10), with or without rim (12), balancing bodies (20) having a high density are fitted into the tyre rubber. The tyre (10) may have extending therearound thickened portions (21, 22) of tyre rubber in which receptors (19) for receiving the balancing bodies (20) are formed.

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A METHOD FOR BALANCING THE TYRES OF AUTOMOTIVE VEHICLES;  
A BALANCED VEHICLE TYRE; AND A VEHICLE TYRE TO BE BALANCED.

The present invention relates to a novel method for balan-  
5 cing vehicle tyres, with or without a tyre rim, with the aid  
of bodies of balancing material, for instance a lead alloy,  
that has a high density in relation to the rubber material  
from which the tyre is made. The invention also relates  
to a vehicle tyre balanced in accordance with the novel  
10 method; and to a vehicle tyre which is to be balanced by  
the novel method.

Hitherto, the tyres of automotive vehicles have normally  
been balanced with the aid of balancing bodies or weights,  
15 preferably made of lead, that are clamped or bonded to the  
rim of the wheel to which the tyre is fitted (c.f. for example  
US Patent Specification Nos 2 049 703, 3 177 039, 3 495 877,  
3 960 409 and 4 379 596). Such weights are readily dis-  
lodged when knocked or otherwise disturbed, for instance  
20 when washing vehicles whose wheels are balanced with this  
type of weight in automatic vehicle washing facilities,  
thereby requiring the wheel to be re-balanced. In order  
to compensate for the relatively small centrifugal-force  
effect to which the weights are exposed due to their location  
25 radially inwards of the actual tyre itself, which tyre is  
normally responsible for the major part and often all of the  
imbalance in the wheel of a vehicle, the requisite balancing;

weights must be given a relatively large mass and will thus afford only a relatively small balancing effect per unit of weight. Because the actual tyre itself is normally responsible for the major part, or all of the imbalance in the wheel of a vehicle, whereas the balancing weights are attached to the wheel rim, which normally exhibits only a slight imbalance, it is often necessary to re-balance a wheel that has undergone a tyre change.

10 It has also been proposed to balance the wheel or tyre of a vehicle by grinding away rubber from the actual tyre itself, normally in the region of the tyre tread, in a manner to achieve balance (c.f. for example, GB Patent Specification 1 407 371). Admittedly the material removed when practicing this method is located at a relatively large radial distance from the centre of the wheel where the effect of the centrifugal force is relatively large, but the density of the tyre rubber is, on the other hand, slight in comparison with the density of conventional 15 tyre-balancing weights and consequently it may be necessary to grind away large quantities of rubber before a satisfactory balance is achieved.

20 The object of the present invention is to provide, for the purpose of eliminating to a great extent the drawbacks encountered with conventional balancing methods, a novel and improved balancing method of the kind in which there

are used balancing bodies or weights of high density in relation to the tyre rubber.

To this end it is proposed in accordance with the invention that the bodies of balancing material are fitted to the actual tyre rubber, when balancing in accordance with a method of the kind described in the introduction. When practicing the method according to the invention it is possible to ensure with the aid of simple means that balancing bodies fitted to the tyre rubber will remain positively seated therein. Because the balancing bodies are positioned in the tyre radially outside the rim, there is obtained a greater balancing effect per unit of weight than when balancing bodies are attached to the rim in a conventional manner. Since a tyre is normally responsible for the major part of, or all of the imbalance in a vehicle wheel, it is possible when using rims of good quality to move a tyre that has been balanced in accordance with the invention from one wheel rim to another without needing to re-balance the wheel.

Preferably pocket-like receptors are formed in the tyre in conjunction with its manufacture or at some later stage, for example, when the tyre is balanced, and filled with the amount of balancing material required to balance the tyre. These balancing-body receptors can be formed, for instance,

by shaping the tyre in a tyre mould that is constructed to this end, or may be formed in the tyre, subsequent to manufacture, thermally or by drilling, milling or some other appropriate technique.

5

According to one embodiment of the invention the balancing material may be in a molten state when introduced into the receptors and allowed or caused to harden therein.

For example, there can be used a metal alloy of relatively

10 low melting point, particularly a lead alloy, which is poured into receptors which have the form of apertures provided in the tyre rubber, and there allowed to solidify and remain. Alternatively, the balancing material may consist of a liquid or paste-like mixture of metal powder, 15 particularly powdered lead, and a setting and binding agent, this mixture being introduced into and allowed to harden in receptors located in the tyre in a manner to balance said tyre, optionally in conjunction with the wheel rim.

20 According to another embodiment of the invention receptors in the form of peripherally extending grooves or channels are formed in the tyre walls and filled with adapted lengths of balancing material strings or stips, therewith balancing the tyre, optionally together with its associated rim. The 25 actual amount or length of balancing material required and the positions at which the material is placed around the tyre walls can be calculated with the aid of conventional balancing machines.

According to a further embodiment of the invention rows of relatively densely located holes are formed peripherally around the tyre, and balancing material is introduced into these holes where the presence of such material is required

5 for balancing purpose. The receptors and the balancing bodies therein are, of course, positioned so as not to be exposed to wear by contact with the road surface. For example, the receptors may be formed advantageously in thickened portions or peripheral beads in the tyre walls, 10 although balancing bodies may also be placed in receptors located in the region of the tyre tread, provided that the balancing bodies are prevented from contacting the road surface.

15 An advantage is obtained when the aforesaid receptors are formed around the whole of the tyre in thickened portions of the tyre rubber formed in the walls of the tyre or in the tread region thereof.

20 The balancing-material receptors may to advantage have sealing means located at the entrance thereof, to prevent ingress of dirt into said receptors.

As beforementioned, the present invention also relates to 25 a balanced vehicle tyre, either with or without a wheel rim, which includes bodies of balancing material having a high density in relation to the density of the tyre rubber,

the balanced tyre according to the invention being characterized in that the balancing material is located in the tyre rubber. It is possible, in this way, to readily ensure that the balancing bodies will be securely seated 5 and have a good balancing effect per unit of weight, at the same time as the balancing bodies will accompany the wheel component responsible for the major part, or all of the imbalance in a vehicle wheel, consisting of tyre and rim, namely the tyre. This will normally allow the tyre to be 10 moved from one rim to another without needing to re-balance the wheel.

Finally, the invention also relates to vehicle tyres, with or without rim, as defined in the claims, which are intended 15 to be balanced by means of the method according to the present invention. These tyres present balancing-material receptors in the form of peripherally extending channels or grooves, or rows of peripherally located holes. An advantage is afforded when the receptors are formed in thickened 20 portions of the tyre rubber extending around the tyre. The receptors may have sealing means located at the entrance thereof, to prevent ingress of dirt into said receptors prior to balancing the tyre.

25 Other characteristic features of the invention are set forth in the following claims and will be apparent from the following description of a number of embodiments of a

balanced vehicle tyre in accordance with the invention illustrated in the accompanying drawings.

Figures 1-6 illustrate, partly in section along a radial plane and partly in perspective, a portion of a first, a 5 second, a third, a fourth, a fifth, and a sixth embodiment respectively of the balanced vehicle tyre according to the invention.

Figure 7 illustrates an alternative balancing body.

10

Figure 8-15 illustrate in section and in end view four alternative embodiments of the balancing-material receptors.

All components which coincide essentially with one another 15 in the various Figures are identified therein by the same references.

In Figures 1-6 the reference 10 designates generally a vehicle tyre having a ply structure 11 molded in the rubber 20 thereof. The tyre 10 is fitted to a rim 12, only partially shown, which includes a wheel-face part 13 and a wheel disc 14 which extends between the wheel-face part 13 and the wheel hub (not shown). The tyre 10 includes tyre walls 15 and a tread 16, which presents patterning indents 17, and 25 shoulders 18 between said walls and tread.

In the embodiment illustrated in Figure 1 a plurality of balancing-body receptors 19 are formed in the two shoulders 18 of the tyre 10, where the tyre rubber is relatively thick. The illustrated receptors 19 have the form of holes which extend substantially laterally into the tyre rubber. 5 The receptors 19 may consist of straight-cylindrical holes or holes which widen towards the bottom thereof, and may be arranged in peripheral rows around the whole of the tyre in the manner indicated, although only the row of holes in the 10 tyre wall 15 which is visible to the viewer can be seen from Figure 1. The imbalance in the tyre 10, or in the wheel assembly 10, 12, and the weight required and the 15 location at which said weight must be applied in order to balance the tyre or wheel can be determined by conventional measuring techniques. Balancing is achieved with the aid of spherical lead bodies 20 having a weight, e.g., of 10 g, which bodies are introduced into respective receptors 19 located around the determined application site in numbers which correspond to the requisite weight required to balance 20 the tyre, or wheel, as determined through the aforesaid measuring process. Balancing bodies 20 of different weights and/or of a shape other than spherical may, of course, be used. It is most suitable from many aspects, however, to use rounded balancing bodies 20 or bodies which present 25 transversely directed fins 30 (Figure 8) for engagement with the defining walls of respective receptors 19. In order to

ensure that the bodies will remain in their respective receptors 19, a suitable adhesive may be introduced into the receptors 19 either prior to or in conjunction with the introduction of said bodies 20 thereinto.

5

Figure 2 illustrates a tyre 10 which is provided with circumferentially extending thickened rubber portions 21 around the sides of the tyre located immediately outside the wheel-face part 13, this thickened rubber portion having 10 provided therein receptors 19 in the form of rows of holes which are located relatively close together. The tyre 10, or the wheel 10, 12, of the Figure 2 embodiment is balanced in the manner described with reference to Figure 1, by means of balancing weights 20 which are introduced into those 15 receptors 19 in the thickened rubber portions 21 found suitable when determining the imbalance of the tyre or wheel assembly.

Figure 3 illustrates a tyre 10, the walls 15 of which each 20 have provided thereon a radially inner thickened portion 21, similar to the portion 21 of the Figure 2 embodiment, and a radially outer thickened portion 22. Both portions 21, 22 extend around the tyre 10 and present receptors 19 in the form of a series of holes. The weights used to balance 25 the tyre 10, or the wheel assembly 10, 12, have the form of round balancing bodies 20 which are introduced into

receptors 19, these receptors being selected so that a balance is achieved. It will be understood that the radially inner portions 21 of the Figure 3 embodiment could be omitted.

5 Figure 4 illustrates a tyre 10 in which receptors 19 having the form of cylindrical holes have been formed in the tread 16 of the tyre, the number of balancing bodies 20 required to balance the tyre 10 or the wheel assembly 10, 12 being introduced into the receptors. It shall be ensured in this  
10 regard that the bodies 20 will not come into wearing contact with the road surface during the life of the tyre, for instance by thickening the tyre rubber in circumferential zones 23.

15 Figure 5 illustrates a tyre 10 having a circumferentially extending thickened portion 24 similar to the portion 21 of the Figure 2 embodiment on each tyre wall 15. Each portion 24 is provided with a receptor 25 in the form of a peripherally extending groove or channel which widens  
20 towards the bottom thereof. In this embodiment the balancing bodies 26 have the form of strips of lead or some other high density metal alloy, which are placed in the grooves or channels 25. It will be understood that the strip 26, which has a constant cross-section, can be taken  
25 from a store and cut into the lengths required to achieve a balance in the tyre or wheel assembly.

Figure 6 illustrates a tyre 10 having a circumferentially extending thickened portion 27, similar to the portion 21 in Figure 2, provided on each tyre wall 15. Each said portion 27 has provided therein a receptor 28 in the form of a 5 substantially laterally directed slot or groove into which balancing bodies 29 in the form of wires, e.g. lead wires, are pressed, the wires being cut to lengths corresponding to the requisite balancing weight.

10 Figure 8 and 9 illustrate in sectional view and elevational view, respectively, a portion of a tyre wall 15 having a modified balancing-material receptor 31. The receptor 31 is provided at the entrance thereof with sealing means 32 which prevent ingress of dirt into the receptor. These 15 sealing means comprise four tyre rubber portions which when forming the receptor 31 have been left in situ in the tyre. The sealing means 32, which define a narrow cruciform entrance opening 33, fill substantially completely the entrance to the receptor 31.

20

Figures 10 and 11 illustrate in sectional view and elevational view, respectively, a portion of a tyre wall 15 having a balancing-material receptor 34. The entrance of this receptor is substantially completely filled by a sealing means 35 25 which is integral with the tyre and defines a arched entrance opening 36 which is to narrow to allow ingress of dirt into

the receptor 34.

Figures 12 and 13 illustrate in sectional view and elevational view, respectively, a portion of a tyre wall 15 having a 5 balancing-material receptor 37 whose entrance is sealed by a sealing flap 38 which is integral with the tyre and resiliently abuts the outside of the tyre wall. The flap 38 has been formed by leaving in situ when forming the receptor 37 a semi-circular tyre rubber portion of the shape indicated 10 in phantom lines at 39, and by pulling out the flap 38 to the position shown in full lines in Figure 12 and 13.

Figures 14 and 15 illustrate in sectional view and elevational view, respectively, a portion of a tyre wall 15 having a 15 balancing-material receptor 40, whose entrance is sealed by a sealing plug 41 having a flange 42, which resiliently abuts the outside of the tyre wall. The plug 41, which is integral with the tyre, has been formed by leaving in situ when forming the receptor 40 a substantially cylindrical 20 tyre rubber portion within the receptor 40 as shown in phantom lines at 43, and by pulling out the plug 41 to the sealing position shown in full lines in Figures 14 and 15.

The invention is not restricted to the aforescribed and 25 illustrated embodiments but can be realized in any preferred manner within the scope of the inventive concept defined in the following Claims.

CLAIMS

1. A method for balancing a vehicle tyre (10) with or without a rim (12) with the aid of bodies (20; 26; 29) of balancing material having a high density in relation to the density of tyre rubber, characterized by fitting the bodies (20; 26; 29) of balancing material into the tyre rubber.
- 10 2. A method according to Claim 1, characterized by forming in the tyre (10) balancing-material receptors (19; 25; 28; 31; 34; 37; 40) and introducing thereinto the amount of balancing material required to balance the tyre.
- 15 3. A method according to Claim 2, characterized by introducing the balancing material into said receptors (19; 25; 28; 31; 34; 37; 40) in a liquid state and causing or allowing the material to harden in said receptors.
- 20 4. A method according to Claim 2, characterized by forming in the tyre walls (15) receptors (25; 28) in the form of peripherally extending channels or grooves, and applying in a said channels or grooves adapted lengths of string-like or strip-like balancing material (26; 29) in a manner to balance the tyre (10).

5. A method according to Claim 2 or 3, characterized by forming in the tyre (10) peripheral rows of relatively densely located holes (19; 31; 34; 37; 40), and by introducing balancing material (20) into those 5 holes which require the presence of such material in order to achieve a balance.

6. A method according to any of Claims 1-5, characterized by forming the receptors (19; 25; 28; 31; 10 34; 37; 40) in thickened tyre-rubber portions (21; 22; 23; 24; 27) in the tyre walls (15) or in the region of the tyre thread (16), which portions preferably extend around the whole tyre (10).

15 7. A method according to any of Claims 1 - 6, characterized by forming in the tyre balancing-material receptors (31; 34; 37; 40) having sealing means (32; 35; 38; 41) located at the entrance thereof, to prevent ingress of dirt into said receptors.

20

8. A balanced vehicle tyre (10), with or without rim (12), including bodies (20; 26; 29) of balancing material having a density higher than the density of tyre rubber, characterized in that the bodies (20; 26; 29) of 25 balancing material are fitted into the tyre rubber.

9. A balanced vehicle tyre according to Claim 8, characterized in that the tyre incorporates

balancing-material receptors (19; 25; 28; 31; 34; 37; 40), selected receptors having accommodated therein the amount of balancing material required to effect a balance.

5 10. A balanced vehicle tyre according to Claim 9, characterized in that the walls (15) of the tyre have provided therein receptors (25; 28) in the form of peripherally extending grooves or channels, wherein said grooves or channels have fitted thereinto string-like or 10 strip-like balancing material (26; 29) in lengths adapted to balance the tyre (10).

11. A balanced vehicle tyre according to Claim 9, characterized in that the tyre (10) has provided 15 circumferentially therearound receptors in the form of rows of relatively densely located holes (19; 31; 34; 37; 40), wherein balancing material (20) is introduced into those holes in which such material is required in order to achieve a balance.

20

12. A balanced vehicle tyre according to any of Claims 8-11, characterized in that the receptors (19; 26; 28; 31; 34; 37; 40) are formed in thickened portions (21; 22; 23; 24; 27) of the tyre rubber in the 25 tyre walls (15) or in the region of the tyre tread (16), said thickened portions extending preferably around the whole of the tyre (10).

13. A balanced vehicle tyre according to any of Claims 9, 11 and 12, characterized in that the balancing material (20) has the form of rounded bodies, suitably substantially spherical balls.

5

14. A balanced vehicle tyre according to any of Claims 9, 11 and 12, characterized in that the balancing material has the form of bodies (20) which present transversely extending fins (30) for holding engagement with the 10 defining walls of the receptors (19; 31; 34; 37; 40).

15. A vehicle tyre with or without rim, characterized in that the walls (15) of the tyre have formed therein receptors (25; 28) which are intended to 15 receive balancing material (26; 29) and which have the form of peripherally extending grooves or channels which preferably widen towards the bottoms thereof.

16. A vehicle tyre with or without rim, characterized in that the tyre (10) has formed therein peripheral rows of relatively densely located holes (19; 31; 34; 37; 40) which form receptors for balancing material (20).

17. A vehicle tyre with or without rim, characterized in that receptors (19; 25; 28; 31; 34; 37; 40) for balancing material (20; 26; 29) are formed in thickened portions (21; 22; 23; 24; 27) of tyre rubber in the tyre 25

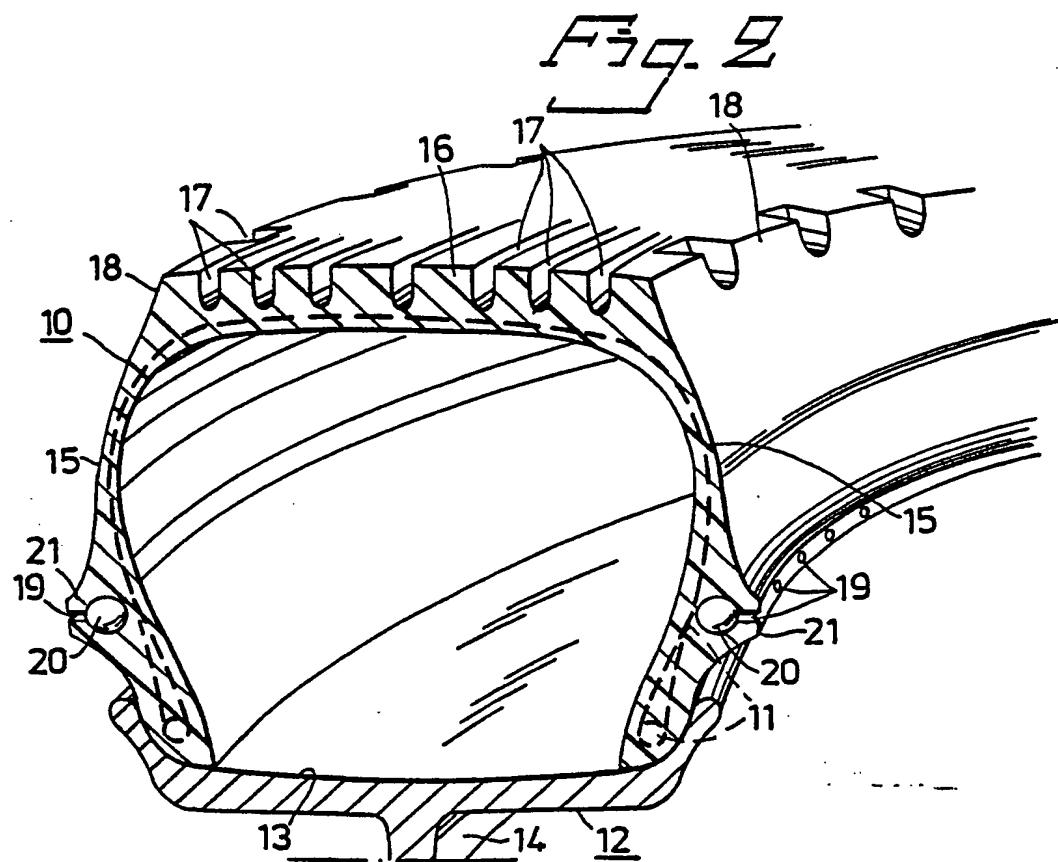
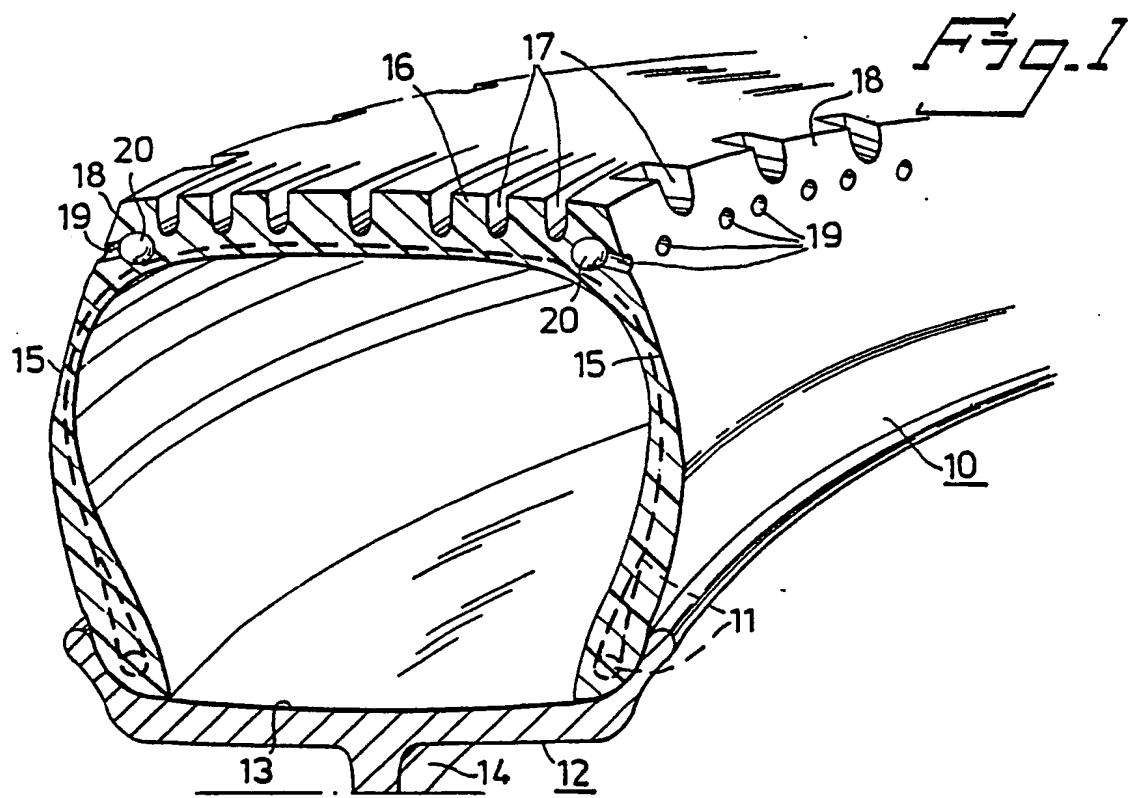
walls (15) or the region of the tyre tread (16), these thickened portions extending preferably around the whole of the tyre (10).

5 18. A vehicle tyre according to any of Claims 9 - 17, characterized in that the balancing material receptors (31; 34; 37; 40) have sealing means (32; 35; 38; 41) located at entrance thereof, to prevent ingress of dirt into said receptors.

10

19. A vehicle tyre according to Claim 18, characterized in that the sealing means (32; 35) comprise tyre rubber portions which when forming the receptors (31; 34) have been left in situ in the tyre rubber so as 15 to fill, substantially completely, the entrance to the receptors (31; 34).

20. A vehicle tyre according to Claim 18, characterized in that the sealing means (38; 41) comprise 20 rubber sealing flaps or plugs which are integral with the tyre (10) and which resiliently abut the outside thereof.



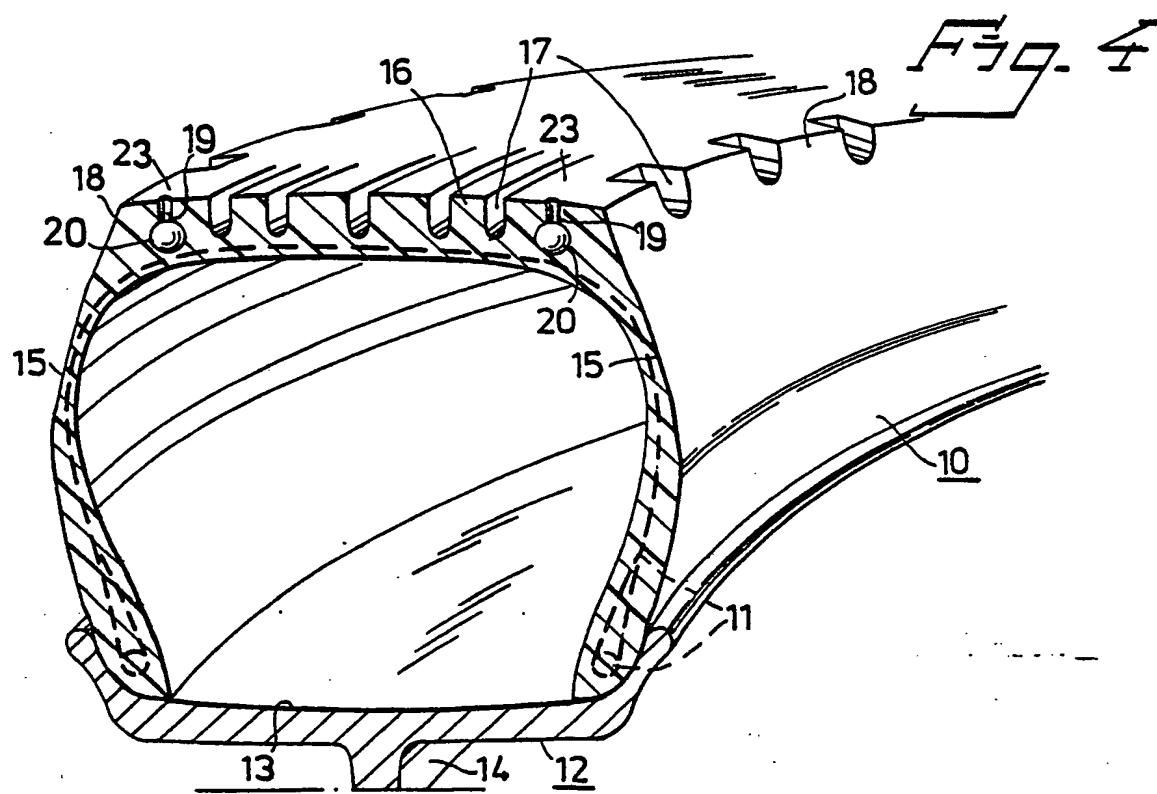
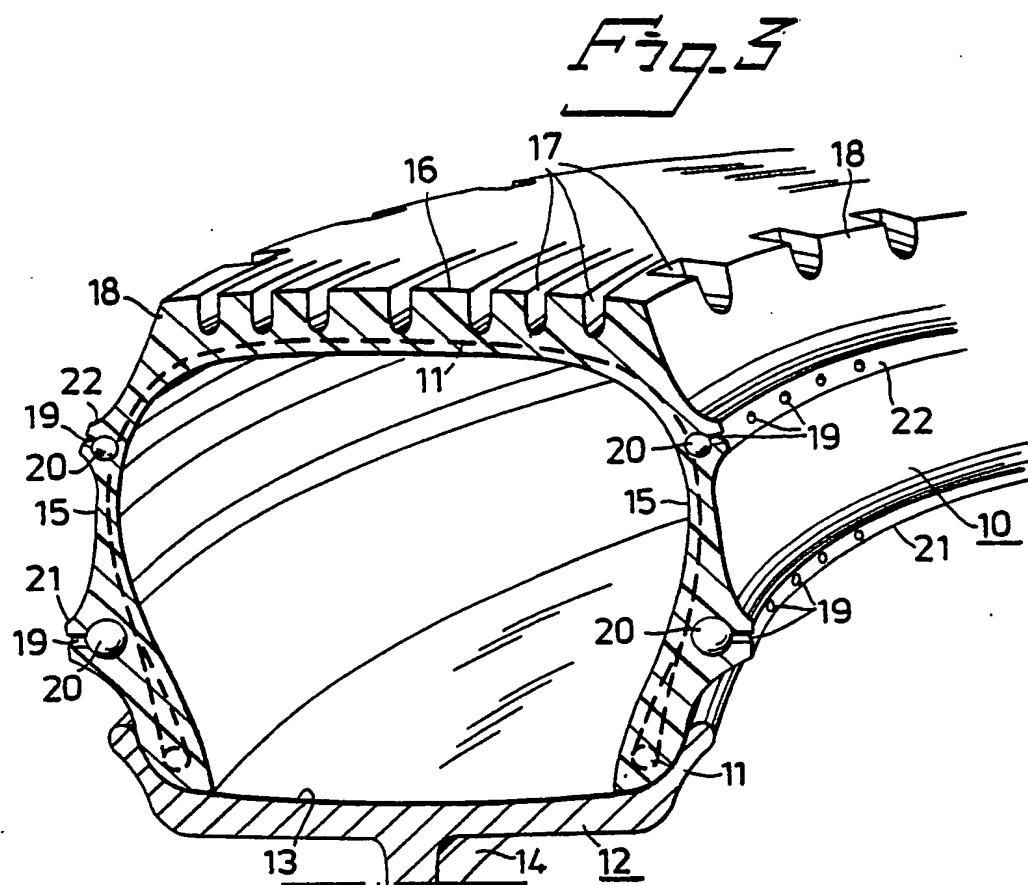


Fig. 5

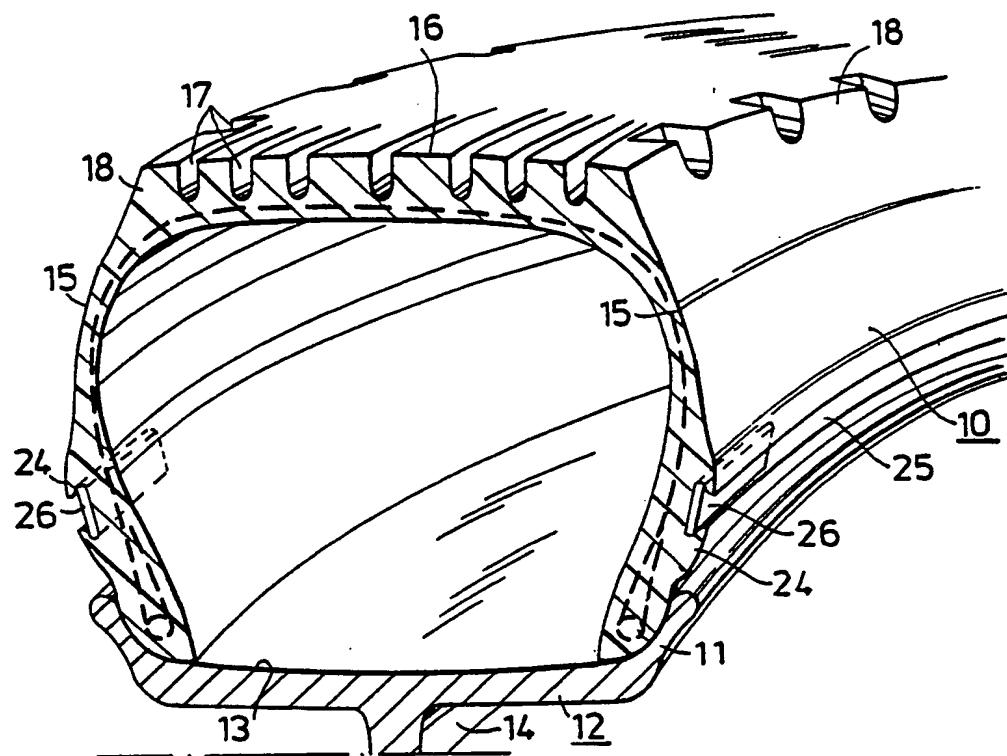


Fig. 6

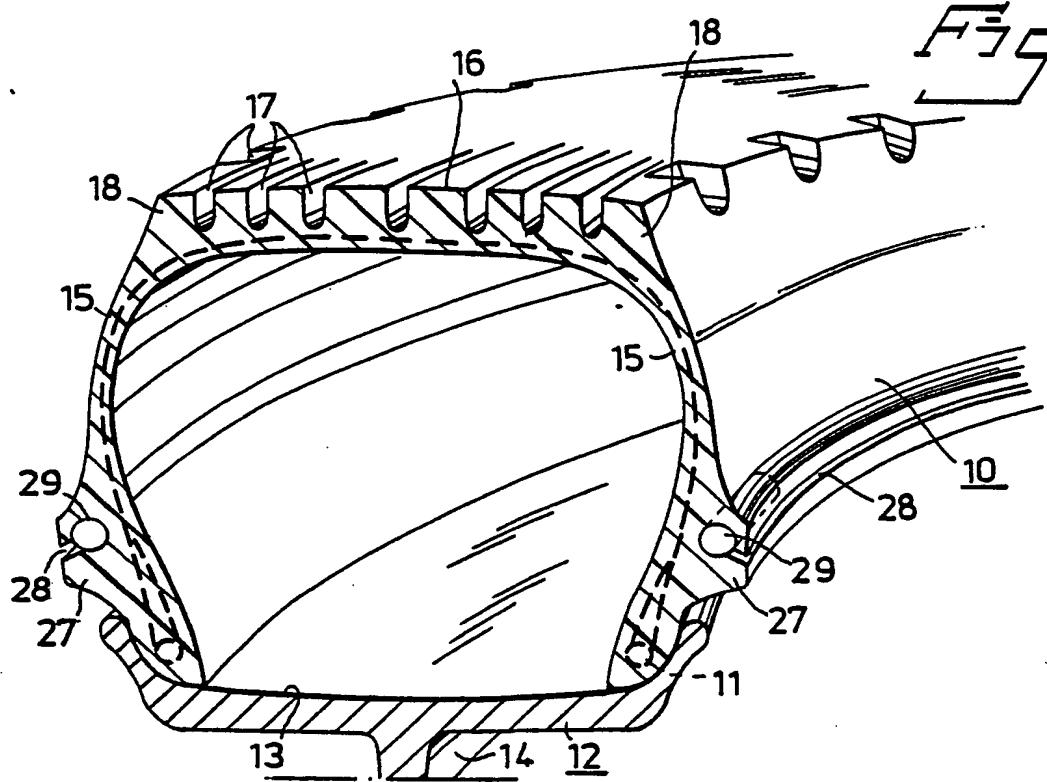


Fig. 7

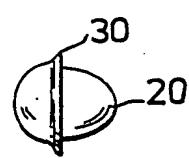


Fig. 8

Fig. 9

Fig. 10

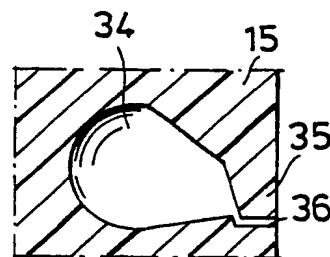
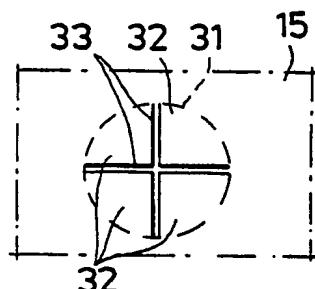
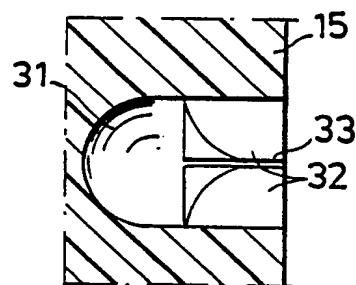


Fig. 11

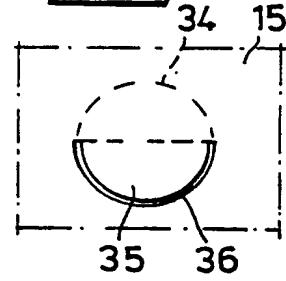


Fig. 12

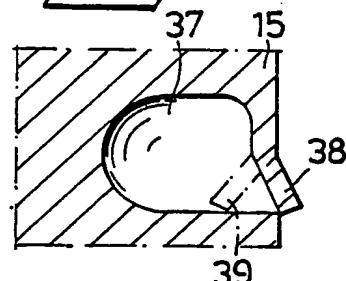


Fig. 13

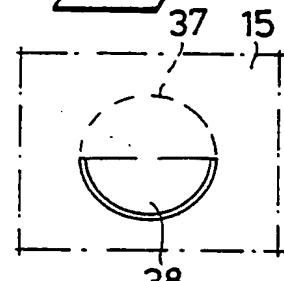


Fig. 14

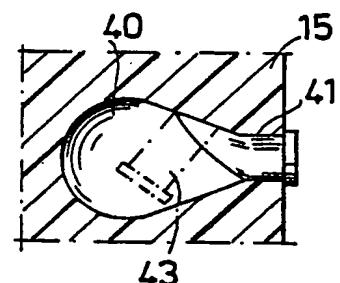
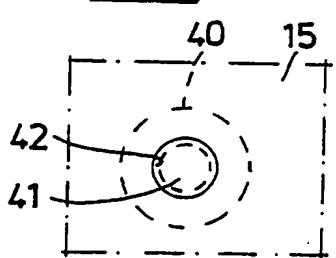


Fig. 15



# INTERNATIONAL SEARCH REPORT

International Application No. PCT/SE87/00261

## I. CLASSIFICATION SUBJECT MATTER (if several classification symbols apply, indicate all) \*

According to International Patent Classification (IPC) or to both National Classification and IPC

G 01 M 1/32, B 60 B 13/00

4

## II. FIELDS SEARCHED

Minimum Documentation Searched ?

Classification System	Classification Symbols
IPC 4	B 60 B 13/00, 15/28; F 16 F 15/32; G 01 M 1/30, /32, /36
US Cl	<u>73:66, 457, 458; 301:5</u>

Documentation Searched other than Minimum Documentation  
to the Extent that such Documents are Included in the Fields Searched \*

SE, NO, DK, FI Classes as above

## III. DOCUMENTS CONSIDERED TO BE RELEVANT\*

Category *	Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages <sup>12</sup>	Relevant to Claim No. <sup>13</sup>
A	US, A, 2 049 703 (J.W. HUME) 4 August 1936	1, 8, 15, 16, 17
A	US, A, 3 177 039 (F.O. SKIDMORE) 6 April 1965	1, 8, 15, 16, 17
A	US, A, 3 495 877 (S.G. MÖRNE) 17 February 1970	1, 8, 15, 16, 17
A	US, A, 3 960 409 (SONGER) 1 June 1976	1, 8, 15, 16, 17
A	US, A, 4 379 596 (GREEN ET AL) 12 April 1983	1, 8, 15, 16, 17
A	GB, A, 1 407 371 (GOODYEAR TIRE & RUBBER CO) 22 May 1973	1, 8, 15, 16, 17

\* Special categories of cited documents: <sup>10</sup>

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"&" document member of the same patent family

## IV. CERTIFICATION

Date of the Actual Completion of the International Search

1987-07-14

Date of Mailing of this International Search Report

1987-07-21

International Searching Authority

Swedish Patent Office

Signature of Authorized Officer

*Hans Bandlin*  
Hans Bandlin

L.E.